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# PROJECT RAND



SPECIAL MEMORANDUM NO. 27

## SOME ASPECTS OF TECHNICAL INTELLIGENCE PROBLEMS IN USAF (U)

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## SUMMARY

This is the first of a series of reports on some aspects of technical intelligence.

The collection, evaluation, and use of technical intelligence, although an established practice in industry (in both its covert and overt aspects) is a relatively new operation in the USAF.

Discussed herein are problems of technical intelligence known to the authors or brought to their attention by the Air Force Air Technical Intelligence Center (ATIC) at Dayton, Ohio. To facilitate the investigations of these problems the subject matter was divided into three major categories:

1. MOSCOW AIR-SHOW PHOTOGRAPHY
2. GROUND LOROP ACTIVITIES (LONG-RANGE OBLIQUE PHOTOGRAPHY)
3. UTILIZATION OF U.S. EMBASSY AIRCRAFT

No attempt is made in this document to evaluate the importance of technical intelligence. It is assumed, however, that cognizance of intelligence requirements and the present day deficiency of adequate information will be understood by most readers. This will be particularly true of those readers who are able to facilitate the suggestions contained herein.

That the sense of urgency has pervaded all phases of this study will be found reflected in the discussions of photographic collection measures which can or are being accomplished right now. Interim steps utilizing present photographic equipment (with and without modifications) which will

aid in achieving the required prompt actions are also examined, and suggestions for changes or innovations, in either instrumentation, techniques, or schemes of operations, are made. A description is included of a research and development activity which, it is urgently felt, should be initiated and maintained until the interim measures can be superseded. Finally, it is shown that this program can be put on a long and firm footing providing a continuous flow of valuable information.

Other memoranda to be published at later dates will discuss the subjects of collecting intelligence of Soviet guided missiles and the possible utility of overflight operations.

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## I. ATIC PHOTOGRAPHIC PROBLEMS

Studies of ATIC's technical intelligence problems reveal certain phases of the intelligence collection operations which seem to be most significant. This first report is limited to the field of direct collection of intelligence data by photographic means. Certain impressions and observations by the authors were inescapable. They are listed briefly only as background context for this report.

First, direct photographic collection of technical information is, in essence, peacetime reconnaissance and, as such, falls within the scope of both scheduled and presently operating peacetime reconnaissance systems and activities. Reconnaissance is unique among normal Air Force combat activities in that it is the only one of such activities which can (and must) be operational during peacetime.

Next, it is fairly obvious that the direct type of intelligence collection is more satisfying than, and appears to be far superior to, the inferences, hunches, extrapolations, calculations, and guesses which (by default) make up a too considerable bulk of intelligence reporting.

Further, we were thoroughly impressed with the (deplorable) fact that the Moscow air show photography is our major source of information about new Russian aircraft. This source of data, controlled as it is by the Russians, is not giving us sufficient, timely, or detailed information.

The above are impressions. Against them must be posed the depression and frustration brought about by considering the limitations, difficulties, and technical obstacles in the collection business. The meager collection that results under these constraints is, therefore, understandable.

Fortunately, even with these limitations and constraints, improvements may be possible. It is with these that this report is concerned.

## II. MOSCOW AIR-SHOW PHOTOGRAPHY

### GENERAL

One of the better known and more valuable opportunities available to collect direct and useful intelligence on Russian weapons of interest to the Air Force, in particular aircraft, is the Moscow air-show series. There are three air shows per year, exclusive of the practice flybys associated with these air shows. These are, the annual Air Force day air show, the air parade on May Day, and the show on the anniversary of the revolution, November 7. The Air Force show takes place at Tushino airfield some distance from the center of Moscow. The other two air parades pass over the Kremlin and Red Square areas, and thus are more or less visible from our present Embassy location.

The assumption of these notes is that significant data are obtainable at these air shows. An interesting series of observations relating to these air shows is contained in R. L. Garthoff's memorandum, RM-1327, titled "Some Observations on Soviet Disclosure of New Aircraft." This memorandum contains a discussion of intentional and unintentional disclosure, but as noted immediately above, this type of discussion is outside the province of this particular technical note.

Sufficient has been learned from the various air shows to indicate that most new Russian prototypes or pre-production models are displayed at the air-shows. Clearly it would be desirable from the intelligence viewpoint to be able to photograph these new models of military aircraft at an earlier stage of their construction and development. In general, however, these opportunities have been denied.

Cameras mounted with, or disguised within, binoculars, small hand-held

amateur cameras and other such gadgetry as may be permitted a pedestrian observer, have been used to obtain aircraft photos, but there is little question that the major (and by far best) way of getting photographs of these aircraft is from the roof of the Embassy building.

The American Embassy has lately been moved a rather considerable distance (from the photographic viewpoint, at least,) from the flight line which passes over the Kremlin and Red Square. A very rough map measurement indicates this distance (that is, from the present Embassy building to the line of flight) to be on the order of 4700 feet; and this is the closest distance to that flight line. This fact makes photography of a type useful for technical intelligence purposes difficult, and poses the immediate and obvious requirement for the use of precision, long-focal-length lenses. Forty and eighty inch focal length lenses, on which are mounted Leica-type cameras, were used. In fact, the pictures taken at the last May Day show in 1954, and which are generally acknowledged to be the best yet obtained of Russian aircraft, utilized these lenses. The very narrow angle of view (a film size of 1 inch by 1 1/2 inches on an eighty-inch camera is an angular coverage of approximately $0.7^{\circ} \times 1.0^{\circ}$) makes the problem of aiming these camera, keeping the aircraft in view, and during all this, focussing the cameras, a difficult bit of practical photography. An alternative way of describing this very narrow field of an eighty-inch lens on a Leica camera is to note that at a distance of one statute mile the 1 inch by 1 1/2 inch field of the camera on an eighty-inch focal length lens covers a field of but 65 feet by 100 feet. This certainly indicates the difficulty of the aiming problem. Further, and fairly obvious, is the requirement to get the entire aircraft being photographed on one frame. Camera systems which could photograph but part of an

aircraft may be of some interest and applicability for detailed study of particular parts of the aircraft. But for any type of measurement or overall analysis, it is imperative that all of the airplane be on one photograph.

A word is in order about the potential intelligence yield from analysis of aircraft. Given fairly accurate information on aircraft shape and size, number and size of engines, an able analyst can make useful and significant statements about performance of this type of photographic operation. Certainly and obviously the pictures obtained must be clear, sharp, and of sufficient scale and definition to permit observation of details and to make measurements. Second, and perhaps more difficult, there must be obtained sufficient data to enable the making of accurate measurements. This photogrammetric data must include such information as range, angle of aircraft flight line to line of sight, and other data which will enable complete geometric orientation of the aircraft with respect to the observers. In the past, because of limitations of equipments and techniques used in acquiring this air show photography, data on size of the aircraft under study was obtained from consideration of sizes (presumably known) of an accompanying or nearby aircraft. Unfortunately, making such arrangements is a matter which is in control of the Russians and not at all within our control. It would appear useful, therefore, to devise a system which gives us what may be called photogrammetric capability on an autonomous basis. We must be able to determine the angles and dimensions without reference to accompanying aircraft or to analogies. It is, therefore, to these two problems: (a) getting high quality photography of sufficient detail for analysis and (b) getting such information as will permit absolute measurements of size and shape, that this phase of the memorandum is addressed.

EMBASSY PHOTOGRAPHIC PROBLEMS

It is impossible to consider this problem in a realistic framework without a good feel and understanding of the limitations and difficulties of the Moscow operations. Fortunately, the authors were able to talk to the two sergeants who acquired and produced the last air show photographs. In addition, meetings were possible with the technical people at ATIC who are most intimately involved in this collection phase of the operation.

It appears that large, obvious and highly technical equipments cannot be erected on the Embassy roof. Such equipments as are used are semi-concealed. By this it is meant that an attempt was made to conceal the apparatus but it appears that these are motions which are designed as to not constitute an obvious affront to the Russians; they undoubtedly know full well what is going on.

The first topic of discussion is the measurement problem; that of obtaining range from the camera site to the aircraft being photographed as well as the angle between the line of sight and the aircraft flight line. Several systems were considered briefly and all but one were rejected.

An obvious suggestion for this sort of problem is the use of a stereo camera arrangement where the full length of the Embassy building might be considered for the stereo base. This means having a camera at each end of the building; both cameras trained on the same object, and then making measurements of absolute parallax to determine range. The difficulties of performing this operation in such a fashion as to yield good, hard, precise numbers are enormous. The major problem is that of having and maintaining camera axes exactly parallel or, if not parallel, at known and slight angles to each other. This does not seem practicable within the limitations imposed by the operation. On the other hand, this technique might yield interesting

views of the aircraft, which, while not useful for measurement purposes, might still be of interest for just visual examination of the aircraft and its structures. But fortunately this is perfectly possible from one camera station, so there is no need for actual stereo photography. As the aircraft under observation flies along, it obviously presents different views to the roof-top observer. Hence, successive pictures of the aircraft, or certainly selected pictures spaced properly could be examined stereoscopically on the assumption that there is not too violent a change in angle of view from one to the other. This is exactly the way in which stereo photographs are accomplished from the air. The aircraft flies along with one camera taking successive pictures from somewhat different viewpoints of objects on the ground. These photographs can then be examined stereoscopically. The only requirement is that there be two photographs of each object. This is performed in the case of aerial photography by cycling the camera at an (easily determined) interval which will accomplish this end.

The problem in the present case is exactly the reverse of this one. Of course when taking single narrow angle shots of an aircraft proceeding along a flight line the successive pictures, because of changing range, will in general be of somewhat different scale, making stereoscopic viewing more difficult. If the scale change is considerable, say 10 per cent, this makes stereoscopic viewing practically impossible. On the other hand, photographs can be so enlarged or reduced as to reduce the photography to the same effective scale, thus making stereoscopic observation very simple. This then eliminates the requirement of direct stereo photography from two spaced cameras on the Embassy rooftop.

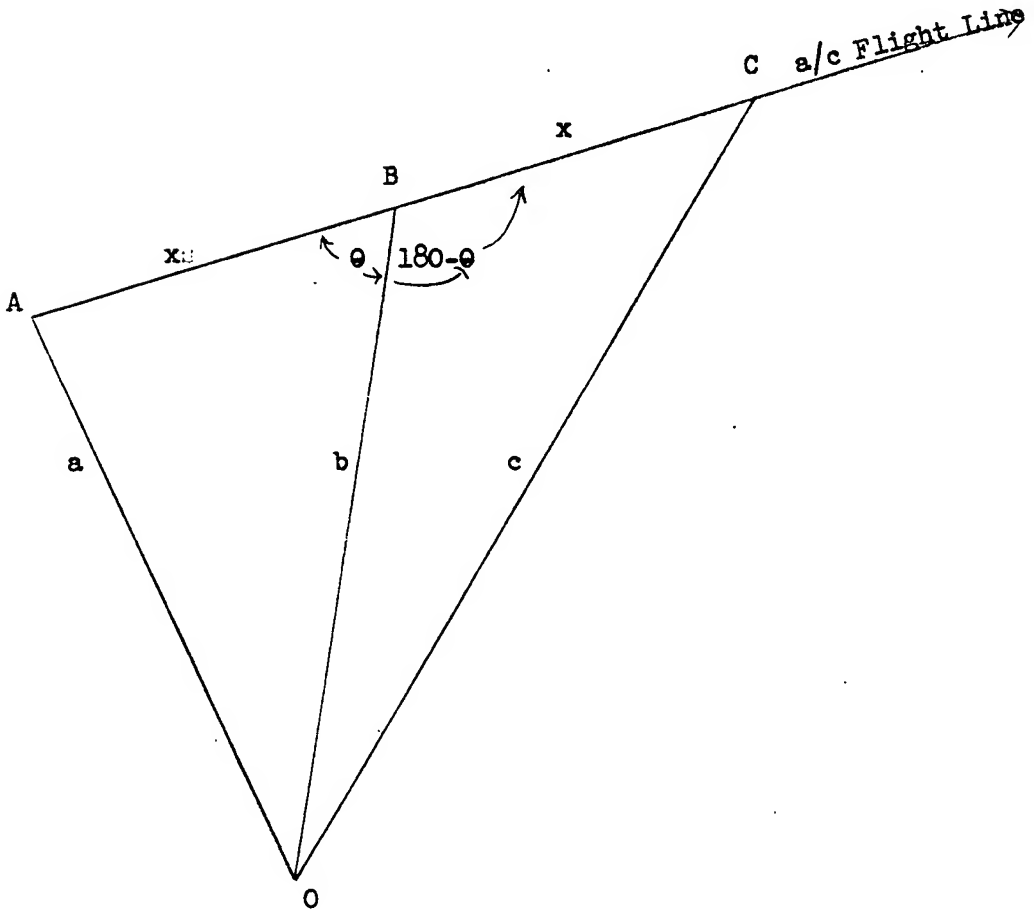
Another suggestion which was examined briefly would have required the use of two buildings. The second building in this case would be that of a friendly embassy such as the British or Canadian Embassy. This would have

required simultaneous photography (in this case synchronized photography is meant) from both stations which could be accomplished only by some sort of electronic or telephonic link. This too seems to be unnecessarily complicated and unreliable for the problem and the conditions which obtain in that area. Too many people, too much coordination, too many possibilities of malfunctioning, add up to a low evaluation of any such system.

The system which is proposed here for experimental evaluation employs an army-type range finder of 1 meter base. It is suggested that the range finder be firmly and securely mounted on an axis perpendicular to that of the long focal length camera axis, thus simplifying the aiming problem. Assuming that nominal range of say 1 mile is preset into the range finder, we would then photograph the range finder images and simultaneously take photographs of the aircraft by a synchronized camera system, all of which could be easily arranged. The range finder photographs would show an image of the aircraft, or rather two images, out of coincidence because it would be extremely unlikely that the aircraft would be at the preset range, except by luck, and certainly for no more than 1 or 2 photographs. It appears not unreasonable to expect an accuracy of measurement of about 1 percent under these circumstances. It can be shown (below) that three photographs of the aircraft equally spaced in time, together with the three corresponding and separate range determinations, are sufficient to obtain complete data on flight line direction and angles of viewing line to this flight line direction. This data will permit nearly complete photogrammetric reduction. One further angle is really needed and this is the elevation angle of the camera. It seems that if this is obtained to 1 or 2 degrees (as can certainly be done by an observer making notes at the time of the photography) this would effectively eliminate the residual small error which

would accrue if we ignore this effect. Thus, three selective photographs equally spaced in time yield a complete solution for the problem of range and measurement determination. An incidental by-product of this data will be aircraft speed. Speed measurement does not seem to be too important, but might prove useful if correlated with other data secured from other devices such as an acoustic analyzer. It is suggested therefore that steps be taken to procure a 1 meter base army range finder of the M-1916 type (or its successor) for example, and perform such experiments as will enable practical feasibility of this suggestion to be tested. The intervalometer which could be used for this operation would be a 24-volt operated instrument and could be obtained from the Aerial Reconnaissance Laboratory or Air Force stock. Thinking here is of the B-5 basic type intervalometer and/or its successors. It is not necessary that the time between successive pictures be known to great accuracy unless it is desired to determine aircraft speed. It is important that the time interval between pictures be very closely the same and for this job this intervalometer is particularly suitable, for it has greater precision (repeatability) than accuracy (true value). However, it can be calibrated easily if aircraft speed determination is deemed worthwhile.

The basis for our earlier discussion of one-station photogrammetry is found in the simple drawing below.




CAMERA STATION

A, B, C are the three equally spaced aircraft positions. (These are not necessarily successive exposures.) We assume that ranges a, b, and c are furnished from analysis of range finder data.

Since all angles are determinable by elementary trigonometric methods, when all sides are given, we need only give the solution for the A B distance. This is x in our diagram, and is the advance of the aircraft on its flight line. It is easily shown that

$$x = \sqrt{\frac{a^2 + c^2 - 2b^2}{2}}$$

To determine scale in one of the aircraft photographs, the range must be used and corrected for the angle between line of sight and line of flight. It is believed that this brief exposition of the essentials is sufficient, and that the people doing this analysis can pick this up from here.

In response to requests from ATIC to recommend sources, organizations, and people who can work in the areas discussed above, the following suggestion for the more immediate Moscow air show problem is offered.

An ideal group, well equipped with clearances, background experience, optical, shop, and all other required facilities and know-how, is the Boston University Physical Research Laboratory at 700 Commonwealth Avenue, Boston 15, Massachusetts. This organization is highly recommended by the authors.

Minimum requirements for the Moscow photography are:

a. Obtaining the range finder from the Army.

b. Experimenting with photographic recording of the range finder images.

c. Coupling the range finder and camera axes at a fixed $90^{\circ}$ angle.

d. Synchronizing the range-finder recording camera and the main camera, and operating both off intervalometer control.

e. Developing techniques for use of this equipment.

There are numerous other minor recommendations and suggestions to be made with respect to camera techniques, focussing procedures, tripod utilization, film choice, development techniques, and mechanical and optical aids to analysis. Because of the dearth of time, in contrast to the requirement to get something started soon, this particular report is being issued in (regretably) an incomplete state. The points raised above will be discussed separately in other memoranda and reports, which should be forthcoming soon.

## III. GROUND LOROP

As explained above, LOROP means Long Range Oblique Photography. The word was coined by one of the authors several years ago to define and lend dignity to the specialized operation implied by the meaning. This word is now in generally accepted use in reconnaissance. Long range is purely relative to conventional routine ranges. As now used in USAF, it means photography of targets 20 to 100 miles or more away with lenses whose focal lengths are at least 100 inches. Two interesting problems in this category are discussed below.

### ST. LAWRENCE ISLAND PROJECT

The first problem to be discussed under this general heading is photography from St. Lawrence Island of Russian shipping traversing the narrow straits off the Chukotski Peninsula. It appears that Russian northern bases are supplied by ships going around this peninsula, and that an accurate and continuous surveillance of this shipping, if done with sufficiently powerful equipment, might permit the inspection of deck cargo, note frequency of passage, and in some measure get a rough idea of the amount of activity. This project and the ideas behind it were called to the attention of the authors and discussed with them by Colonel M. D. Seashore of ATIC, who visited this region recently.

From a 700 ft. high vantage point on St. Lawrence Island, one can survey (according to the rough formula for horizon distance and neglecting refraction, which works in our favor) out to some 33 statute miles. The closest distance from St. Lawrence Island to the Chukotski Peninsula is

about 40 miles. It is not clear what the habits of Russian shipping are; that is to say, whether or not they stay close enough to shore to be below our horizon distance. This is a point which must be investigated further.

The photographic equipment contemplated by ATIC at this time for this job is a 200 inch f/25 camera. While this is undoubtedly a fine piece of equipment, it is the feeling of these writers that it is not quite adequate. Ships can be photographed, but examination of deck cargo seems below the resolution threshold. Fortunately, from the photographic standpoint, (if not the climatic) this particular problem is a photographer's dream. The island is ours, the equipment is ours and presumably we are in friendly territory. The limitations imposed are those of nature only and are not at all comparable to the type of limitations imposed by use of aircraft or by the requirement of having to accomplish this photography in otherwise unfriendly areas or in a covert manner.

These factors mean there should be no real limit imposed on the kind of photographic equipment to do this job, if the job is worth undertaking at all. This simply means that the cost of transporting anything up there, the rigors of the climate, the loneliness of the outpost and the unrelieved monotony of the task are initial costs of a very large amount. Taking all of these circumstances in consideration it seems advisable to go a little further and procure equipment which will really pay off.

On the assumption that the shipping will be 33 miles away (horizon distance) one may readily calculate that with a 200-inch camera, a scale number of approximately 10,000 is obtained. This is 833 ft. to the inch. A 500 ft. long ship would be roughly .60 inches on the photograph. It is unlikely that sufficient detail to permit accurate identification of deck cargo will result from such photography.

It seems to these writers that a focal length which would be more applicable for this job would be of the order of 500 inches. This should not cause undue alarm in the unwary reader. Modern cameras, similar to those used in special reconnaissance activities, are usually of the telephoto design. The over-all length of such systems, from the front lens to the focal plane, is approximately half the total focal length. Furthermore, these cameras are easily folded optically so that their total bulk is much less than may be imagined from looking at the number 500 inches.

Considerable and valuable design experience with modern cameras (both ground and air) has been accumulated; this means that the problem at hand is capable of neat solution.

It appears likely that with a 500-inch focal length camera mounted on the island and mounted suitably so as to be free of vibration wind currents, extreme temperature gradients, and other factors which degrade quality, should be capable of yielding a minimum resolution on standard film of at least 10 to 12 lines per millimeter. This corresponds to an angular resolution of about 2 seconds of arc. This figure, which we will use hereafter for working purposes, is a factor of 5 or so below the theoretical limit of a moderate aperture photographic telescope of 500 inches. In this case we are talking about a camera with an f/number of about 25 or 30. Theoretical resolution of a lens of this type, (which could well be realized with a properly designed instrument) is of the order of 50 or 60 lines per mm. The resolution of the film we might employ for this test should be higher than this lens limit. Because we are not intending to use this camera in the air or to photograph a high-speed target (let us assume a ship's speed of about 15 knots or so) it is clear that we could use fairly slow shutter speeds, accompany this with high resolution fine grain film

having good micro-contrast characteristics and achieve superb results. To go back for the moment to the question of shutter speeds and image speeds, if we assume as we did immediately above that the ship's speed is of the order of 15 knots, this speed at the focal plane of the camera (considering that we are reducing this speed by the scale factor of 4000) will give us an image speed or blurring effect of about 1.75 mm per second. This image speed has its effect on the image, of course, only during the exposure time and its effect is cut in direct proportion to shutter speed. Assuming again that we will use shutter speeds of the order of a fiftieth of a second, (not out of reason for the conditions of the problem at hand) the result will give us a blurring or image motion which is of the order of a twenty-fifth of a millimeter. Fortunately, for reasons having to do with threshold effects and the sensitometry of the film, this amount of motion should permit resolution of the order of thirty-five or forty lines per millimeter. It should be clear now that the kinds of numbers we have in mind for this system for focal length, shutter speed, lens aperture, film speed, etc., make for a balanced system.

One of the fortunate aspects of this operation is the requirement or need for but a small angular field on the camera. The aerial cameras discussed earlier all require relatively large angular fields. Thus, the smallest airborne 240-inch camera in use or proposed would have a field format no smaller than 9 by 18 inches; and cameras of this size with much larger fields have been used. On the other hand, any ship at the target distance of 30 odd miles presents a very small target. (A 500-ft. long ship, at a scale of 4000, is but 1.5 inches on the photograph.) The consequent reduction in optical design problems is enormous. Thus, we could easily (and undoubtedly with benefit to the optical designer, the operator

in the field, the man in the processing laboratory, and all who subsequently handle the film) standardize on the film size of perhaps 4 by 5 inches, a standard, commonly available, and easily handled film.

Besides the large camera, we should have a visual spotting aid, a telescope of perhaps 50 to 60 power which could be used in aiming the large camera and making the small angular correction movements we might anticipate. Unfortunately, an elegant camera such as this one and, in fact, any photographic piece of equipment, is useless during obscurity like cloud or darkness (unless the ship mounts ome strong lights). To this end it is suggested that a relatively simple radar be used for ranging in the daytime (it would not have to be used except on a very infrequent basis for this purpose). The main use of this radar would be to count traffic during those portions of the day or weather spectrum which are closed to photography by the large camera. Clearly it would avail us little to have fairly decent information about the cargo and type of a particular ship and at the same time be uninformed by several hundred per cent about the number of ships which have gone by in whatever direction. Thus the use of a radar at night might do simple census taking or gross count, and use of the camera in the daytime would nicely supplement the radar by permitting detailed inspection on a sampling basis. Of course some of the questions raised here, involving use of a radar, cannot be answered from this end. Clearly, the radar, being an active device, might be a security giveaway, or might otherwise be regarded as an impracticable component of this operation. At least this suggestion may be regarded as simply a suggestion for analysis and evaluation of ATIC.

OPERATION FEZ

Operation FEZ, as understood by the authors, is the securing of photography of Russian areas from high vantage points on the Turkish side of the Turkey-Russian border. This photography is accomplished by U.S. personnel equipped with relatively long-focus cameras - cameras of the order, 80 to 150 inches focal length. Fortunately for our purposes, and in fact that which makes the operation both possible, and useful, is the presence not far from the common border of interesting Russian areas. The cities of Batumi and Yerevan, with their associated airfields, are of obvious and immediate Air Force interest.

Conversation with responsible officers at ATIC has revealed that this operation is a very difficult one logistically, involving as it does the climbing of mountains, and the packing in of heavy, cumbersome and delicate camera gear. Furthermore, and for obvious security precautions, the people who do this work must climb these mountains and be in place during hours of darkness so as to (hopefully) prevent detection by observers on the other side of the border. Another condition which makes this at best an uncomfortable operation is the fact that best photo conditions usually occur after a rainstorm and this is undoubtedly not the most pleasant time to climb a mountain. Photographic conditions following a rainstorm are usually good because the rain clears the air of dust particles and other vision-obstructing and contrast-reducing effects in the atmosphere. The net result is that the photography can be secured either at greater distances or at greater contrasts for the same distance. Thus the recipe for good photography does not quite coincide with the recipe for pleasant mountaineering.

Surveillance Aspects

As we look at this operation, we see several points that must be noted. First, ground photography secured in this operation by ATIC should be compared for yield and quality with corresponding photographs obtained by the Air Force from the air. In this way, at least, the value of Operation FEZ as a pioneer tool can be assessed. The way in which the word ''pioneer'' is used here refers to securing original or relatively fresh coverage of the airfields and other areas of interest. Surveillance is, however, an entirely different matter from pioneer reconnaissance. If surveillance of the several observable areas is indeed an important aspect of Operation FEZ, then the surveillance aspect alone will serve to justify this type of mission, together with its physical and technical hardships.

What we are saying is simply this. Inasmuch as U.S. reconnaissance aircraft have secured pioneer coverage of this area, in fact coverage which undoubtedly extends considerably deeper than is possible to secure from ground cameras (if the aerial photographs are better than the ground photographs, as we suspect), then this pioneer aspect of Operation FEZ should be minimized and attention paid to the surveillance aspect. Quite obviously, surveillance on a weekly, monthly, or some intermediate basis by means of our aircraft is not possible at this time. On the other hand, this is certainly possible albeit difficult by means of ground photography. It is therefore perhaps this aspect of Operation FEZ which should be exploited and developed the most.

Photographic equipment used in this operation to date, while undoubtedly of high quality cannot be regarded as other than amateur equipment. By ''amateur equipment'' we mean simply equipment more or less available on the open commercial market and not developed for the job. Equipment

consists of Leica type cameras (Leica or Exakta) mounted on very long focal lenses such as 80-inch or 150-inch telephoto lenses. Lenses used have been made by Bouwers in Delft, Netherlands, at the Old Delft Optical Company, and by Frank Back at Zoomar, in Glen Cove, Long Island. Investigation by the authors reveals that the Zoomar lenses are essentially identical in design and outward physical appearance to those made by Bouwers. Whether this is coincidence or otherwise has not yet been determined but is under minor and low priority investigation. It is entirely possible that detailed study will show that these lenses are not too far from optimum for this type of mission required in Operation FEZ. Were more weight, size and other concomitants of good photography permitted in this situation one could undoubtedly exceed the performance achieved by the present systems - and this with no regard to potential improvements in film choice, development methods and other handling techniques.

Dr. James G. Baker, whose name is invariably associated with the outstanding optical work done in this country for the past decade or more, has recently told the writers about a 400-inch mirror system which would be quite light and small in over-all dimensions. This particular design takes advantage of a material which has not yet been elsewhere used in optical design. This material is foamed quartz, and is made by Corning Glass Company. It is the impression of these writers, who are now getting further data from Dr. Baker on this system, that the expected weight of this optical system will not exceed 10 lbs. nor in length exceed 30 inches. The angular field of this system will probably be that which will cover a 2 x 3 inch area. Use of a rigid tripod during Operation FEZ is not only desirable but mandatory. This should make use of this relatively slow system

possible and it should succeed in securing far more detail than is possible with the present systems.

Recalling the concept of this operation as one primarily useful in surveillance, it seems that further exploration of the surveillance aspects might turn up possibilities of watching military operations in detail on the several fields which can be observed from the Turkish side of the border. We have in mind here the observance of operations which could not be studied from aerial photographs secured on a one-time fly-by, such as turn-around time of MIG's, general operating, timing and scheduling of aircraft movements, engine maintenance and replacement practices, and operations of this general character. This type of requirement might indicate the profitable use of a motion picture or a sequence camera with careful timing control. This might permit us to make fairly complete time and motion analyses for some of these operations. (It should be pointed out that this particular area is one of the few places in the world where we can look directly into Russia from a friendly area. Here certainly we don't go through hundreds of miles of satellite and buffer states.) The type of sequence camera intended here is one which can be pulsed at controlled intervals and which records time, so that the pulsing rate (which must depend very directly on the kind of operation under study) can be varied at the choice of the operator. There are numerous and excellent commercially available cameras of this type, which, when attached to a very high quality lens, would make a powerful combination.

GENERAL REMARKS ON GROUND LOROP

There appear to be some further side advantages to this kind of proposition. Were the camera systems described briefly above designed, constructed, and installed in both the northern and southern areas, we could well use these operations as excellent training grounds for general and further world-wide operations of this character. It is certainly true that one can do long-distance photography under closely simulated circumstances in this country. By the same token it appears difficult to simulate the rigors and difficulties of an actual field operation without doing it in the field. In any event, in this case there is no need to simulate it, because we have the site and are intending to perform the operation. It seems clear that long focal length, large cameras of this type will become an increasingly more prominent feature of ATIC's world-wide activities. It is entirely possible that there are numerous other areas throughout the world which afford us the same benefits of close-at-hand observation permitted in this instance by the presence of St. Lawrence Island in the one instance, and Turkish mountains in the other, so close to the Russian mainland.

A casual look around the map of Asia indicates at least one other potential source of data similar to that which is being obtained from the Turkish boundary. This is at the point at which Norway abuts the Murmansk Peninsula. Whether or not useful intelligence data could be procured about the Murmansk area from some vantage point on the Norway side is not known to these writers at this time, but can and should be investigated.

A leading photographic worker in the Royal Swedish Navy, Captain Ragnar Thoren, has for many years been experimenting with long focal length photography from ground positions. One of the writers has had extensive discussions

with Captain Thoren in years past and was left with the impression that Sweden is undoubtedly doing some of this type of LOROP operation right now. Brief study of the map of Europe does not clearly indicate what could be observed from the Swedish coast or its islands that might be of interest and available to ATIC. But this point is one which ATIC can investigate easier and better than we can here at RAND. There is more than a distinct possibility that Sweden may be doing some work of this nature from its ships. We have in our possession a photograph showing a 10 ft focal length camera mounted on a Swedish ship. This photograph and some of the uses of such equipment are described in a fairly recent and available article by Thoren.

One important and oft-overlooked thought must be inserted at this point, following the hardware discussion above. Items of physical hardware are but one component of a successful operating system. Techniques for successful exploitation and use of the hardware must be developed, not only for the collection tools but for the physical reduction and analysis of data. Such processing equipment and techniques, as well as such gear as may be useful in reduction and analysis of the data, must, in all fairness to the collection gadgets and the lonely crews sitting in remote outposts, be of comparable quality to the camera itself. The laboratory in the home office is no place to degrade data. Whatever data is gathered by the camera must be preserved and transmitted without further loss through the rest of the system. And, of course, people must be suitably trained and in place to operate equipment to its best performance level, as well as others to process the raw data obtained so as to wring the utmost from the data for intelligence purposes. These subjects must be deferred for further and detailed discussion in subsequent reports.

## IV. UTILIZATION OF U.S. EMBASSY AIRCRAFT FOR OBSERVATION

### GENERAL DISCUSSION

Because we do not now have many friendly aircraft flying over satellite and Russian territory, it should be important to exploit to the limit the possibilities afforded by the one aircraft we know about. This is the aircraft assigned to the U.S. Embassy in Moscow. Limitations are imposed by Russian air rules; the fact that this aircraft carries women and children, and is under full control of our ambassador, makes using this plane for military purposes a risky business.

We have heard that the U.S. Embassy aircraft is a C-54, and that it makes approximately one trip per month between Wiesbaden and Moscow. It appears further that this aircraft carries two Russian observers (picked up en route in Berlin) who act as navigator and radio operator during the flight over satellite and Soviet areas. It is our understanding that this aircraft is neither searched, inspected nor at any time entirely in Russian hands. It is guarded and maintained by our own people.

There are several stages of aerial reconnaissance permissible from this airplane. First, and most obvious, there is simply visual observation from the passenger compartment of the airplane. This is probably done now,but because those visual aids which could be of tremendous help in such work have only recently come under development, this type of surveillance is probably low in effectiveness, relative to its potential. Next, we may consider photography from the aft compartment with small hand-held cameras. Highest on the list of reconnaissance techniques is photography employing concealed cameras. For example, small, automatically operated cameras could be installed in the baggage compartments. We will discuss these in the order listed above.

VISUAL OBSERVATIONS

For the case of visual observation, the performance of the eye can almost always be improved by the use of a visual aid such as a low power monocular or binocular. The major difficulty in using standard binoculars, for example, 6 x 30, 7 x 35, 7 x 50, (the most popular and readily available sizes) for aerial observation has been that aircraft vibration is transmitted to the instrument, and magnified in proportion to the power of the binocular, thus destroying image quality and inducing eye fatigue. Under severe vibration conditions it is entirely possible to induce nausea in the observer. For exactly this reason the use of an internally stabilized binocular, stabilized in such a way to exclude aircraft vibrations from affecting image quality, would be uniquely valuable and immediately applicable in this very rare opportunity for the U.S. to survey Russia from the air. Such binoculars have been under development for the last year or two by the Aerial Reconnaissance Laboratory at WADC. No electronic or electrical gadgetry is employed; the binoculars are stabilized optically, and all parts are inside the instrument.

The authors have seen and tested these binoculars briefly. The performance of the experimental models in stabilizing the visual image is truly amazing. Much more extensive tests have been accomplished by numerous Air Force personnel who have had occasion to actually use these binoculars in the air. One of the several available binoculars of this type is now being used by USAFE for corridor observation in Europe. There is little question that this fairly inexpensive, readily available and altogether remarkable device would aid considerably in observation from the aft compartment of the C-54. In sum, therefore, if visual observation from this aircraft is at all useful, (as it certainly appears to be) the use of this aid should multiply its effectiveness by perhaps a factor of 3 or 4. Further details about this

instrument and its availability, can and should be secured directly from the project engineer at the Aerial Reconnasisance Laboratory, Mr. Richard Nierenberg.

PHOTOGRAPHIC OBSERVATIONS

Photography with small hand cameras could be accomplished from the passenger compartment of the C-54, especially if this compartment is not visited by the navigator and the radio operator. It would appear that there is little question that the Russians assume we are doing this anyway. If this is true, we might as well do it efficiently. One of the authors has had well over a hundred hours photographic experience from C-54 aircraft. It makes an excellent photographic platform, especially if one or two of the round ports (say, one on each side) are designed so as to be easily removable. Photography through the plexiglass windows leaves much to be desired in the way of quality. This particular bottleneck can easily be eliminated by making the windows removable or by enlarging the center plug. We have in mind here photography with cameras of the Leica type. Some experience with these cameras is necessary before these cameras can be successfully used with long lenses such as 4 or 6 inches in focal length (which could serve to record items of military interest several miles away). On the other hand, this experience is easily obtained and more easily learned via competent instruction.

Of course, any such photography would be almost valueless if it proved to be impossible to identify the spot at which the photography was taken. This implies that anyone doing such photography must keep careful record of time of the photography and this record must be coordinated with the notes, log, and memory of our Embassy pilot. It is understood that in general the Russian navigator flies the airplane on some sort of dog-leg route, which is not known to the American pilots and crew ahead of time; further, the route

is seldom the same from trip-to-trip. On the other hand, it should prove possible to make and keep a record of the route flown. This latter statement is a suggestion only; the implementation must be left to the American crew aboard, who can probably devise a perfectly adequate scheme. The change of route guarantees more coverage than possible from a fixed and oft-repeated route.

Photography from the Embassy airplane using concealed cameras operated remotely is entirely another matter. The technical feasibility of this proposal has previously been looked into at some length by two Air Force personnel known to one of the writers. They are Major Charles B. Randall at Headquarters USAFE, DCS/Intelligence, and Major Fred Yochim of the Aerial Reconnaissance Laboratory at WADC. In the summer of 1953 when Major Yochim was in Europe, he and Randall did some experimental work using special Leica cameras obtained directly from Leitz, at Wetzlar, Germany. From what we hear, these results were interesting and promising. They showed what could be done with very small cameras, skin-mounted in airplanes of the type in discussion. Admittedly, this is a matter of considerably greater gravity than the use of a personal camera, which can be put in baggage or otherwise concealed. It seems to these writers that this should not be attempted until the use of a hand-held camera by trained personnel demonstrates either the limitations of that method or the potential advantages of the concealed camera mounted within the aircraft.

As a parenthetical comment on the state of our intelligence stockpile, and the devious methods by which we must pick a crumb here and refine a piece of ore there, this particular discussion of possible use of the Embassy aircraft is noteworthy. It is only because of the dearth of fresh intelligence, and the consequent necessity to explore every possible method of obtaining needed

data that one would even consider such a proposal. We may contrast this with the easy photographic opportunities afforded by passengers on U.S.A. airlines. R. B. Murrow of The RAND Corporation has pointed out very effectively that proper scheduling on commercial airlines would take a casual visitor over more than 90 per cent of our SAC bases. Unfortunately, we do not have such opportunities in Russia.

In order to properly evaluate this particular method of collection for our intelligence purposes - that is, visual and photographic observation from the monthly Embassy aircraft flights to Moscow, it will be necessary, (a) to examine the types of reports now made from visual observation from this airplane, (b) to get some idea of the variation in routes actually flown so as to estimate the total area coverage by this airplane, and (c) to obtain information on types of targets which are likely to be seen from this aircraft. This type of study must await further visits and consultation with ATIC people.